Georgia

REASONABLY FORESEEABLE DEVELOPMENT SCENARIO FOR FLUID MINERALS

Prepared for:

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
EASTERN STATES
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May 2008

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include air, fish and wildlife, minerals, paleontological relics, recreation, rangelands, scenic scientific and cultural values, timber; water, and wilderness.

BLM/ES/PL-08/XXX

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ACRONYMS

ACEC	Area of Critical Environmental Concern
APD	Application for Permit to Drill
AU	Assessment Units
BCF	billion cubic feet
BLM	Bureau of Land Management
BOPD	barrels of oil per day
CBNG	Coal Bed Natural Gas
EIS	Environmental Impact Statement
EOR	Enhanced Oil Recovery
ESA	Endangered Species Act
EIS	Environmental Impact Statement
JFO	Jackson Field Office
MMBO	million barrels of oil
RFDS	Reasonable Foreseeable Development Scenario
ROD	Record of Decision
RMP	Resource Management Plan
SMA	Surface Management Agency
TCF	trillion cubic feet
TPS	Total Petroleum Systems
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey

Summary

1.0 INTRODUCTION

The Bureau of Land Management's Jackson Field Office is located in Jackson, Mississippi, and is responsible for 11 southern states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. The Jackson Field Office manages approximately 34.25 million acres of federal mineral estate in the eastern portion of the United State. Of this approximately 15 million mineral estate acres are located in Georgia, however there is current no oil or gas production on federal minerals.

The Reasonable Foreseeable Development Scenario (RFDS) forecasts fluid mineral exploration, development, and production for the planning area for the next 10 years. The RFDS assumes a baseline scenario in which no new policies are introduced and all areas not currently closed to leasing and development are opened for oil and gas activity.

Interagency Reference Guide - Reasonably Foreseeable Development Scenarios and Cumulative Effects Analysis for Oil and Gas Activities on Federal Lands in the Greater Rocky Mountain Region" (USDI 2002), "Policy for Reasonably Foreseeable Development Scenario (RFD) for Oil and Gas (BLM WO IM No. 2004-089) and Planning for Fluid Minerals Supplemental Program Guidance (BLM Handbook H-1624-1) guided the criteria and analyses methods used in this RFD.

1.1 Discussion of Determining Oil and Gas Resource Potential

Potential accumulations of oil and gas are described in Section 2. Non-BLM land within the state may be included in this section when it provides a better understanding of resource potential on BLM property. These determinations were made using the geologic criteria provided by reference in Section 2. Also contained in Section 2 are descriptions of stratigraphy, structure, historic oil and gas activities, as well as relevant studies done in the area. Potential reservoir rocks, source rocks, and existing stratigraphic and structural traps are discussed in detail.

1.2 Methodology for Predicting Future Oil and Gas Exploration and Development Activity

Section 7 predicts the type and intensity of future oil and gas exploration and development activities. These forecasts are determined by an area's geology, and historical and present activity, as well as factors such as economics, technological advances, access to oil and gas areas, transportation, and access to processing facilities. Economics, technology, and other factors may be hard to predict because of their complex nature and rapid rate of change. Projections of oil and gas activities are based upon present knowledge. Future changes in global oil and gas markets, infrastructure and transportation, or technological advancements, may affect future oil and gas exploration and development activities within the state.

1.3 Relating the Potential for Resource Occurrence to Potential for Activity

Predicted oil and gas activity does not necessarily correlate with geologic potential for the presence of hydrocarbons. Although the geology of an area may suggest the possibility of oil and gas resources, actual exploration and development may be restricted by high exploration costs, low oil and gas prices, or difficulty accessing the area due to lease stipulations. Thus a small area may have a high resource potential, yet have a low exploration and development potential due to severe restrictions on access. Conversely, technological advancements or an increase in oil and gas prices could result in oil and gas activities in areas regarded as having low potential for occurrence.

2.0 DESCRIPTION OF THE GEOLOGY OF GEORGIA

The state of Georgia spans four distinct geologic regions, from northwest to southeast, those four regions are the Valley and Ridge, The Blue Ridge, the Piedmont, and the Coastal Plain (see Figure 1 Geologic Regions of Georgia).. All of these geologic regions extend into the surrounding states, but Georgia is the only state south of Virginia to have all four regions (UGA, 2008). No oil or natural gas has been produced from this state and no applications for oil and gas drilling have been made to the state in recent years (Costello, 2008). If oil and gas is to be found in the state, it would appear to be most likely in the Valley and Ridge and Coastal Plain regions.

2.1 The Valley and Ridge

The Valley and Ridge consists of Paleozoic sedimentary rocks that have been folded, faulted, and deeply eroded to form long NW-SE trending valleys and ridges that give the region its name. Most of the faults are thrust faults in which sheets of limestone, sandstone, and shale have been pushed northwestward on top of each other. Figure 2 presents the geologic units of Georgia. The strata of the Valley and Ridge include numerous carbonate units and thus caves and other karst features are scattered across large parts of the region. While coal has been mined from the NW corner of the state, the Valley and Ridge region has not produced oil or gas.

2.2 The Blue Ridge

The Blue Ridge is a region of severely folded and faulted, low- to high-grade metamorphic rocks. Many of the rocks within the region appear to be metamorphosed Proterozoic or Paleozoic sedimentary rocks. Others are metamorphosed igneous rocks. The Blue Ridge region forms the North Georgia Mountains or the Southern Appalachians. The topography is not as bedrock-controlled and orderly as that in the Valley and Ridge. Drainage systems are generally dendritic, whereas they are linear in the Valley and Ridge. Georgia forms the southwest end of the Blue Ridge, which extends NE to Virginia through Great Smoky Mountain and Shenandoah National Parks.

2.3 The Piedmont

The Piedmont is a region of moderate-to-high-grade metamorphic rocks and igneous rocks like granite. Topographically, the Piedmont consists of rolling hills. Isolated granitic plutons rise above the Piedmont as prominent features like Stone Mountain.

2.4 The Fall Line

The Fall Line of Georgia marks the contact of the Piedmont with the Atlantic Coastal Plain. The Fall Line is a boundary of bedrock geology between the metamorphics of the Piedmont and the largely unconsolidated sediments of the coastal plain, but it can also be recognized from stream geomorphology. Rivers crossing the Fall Line show falls or rapids and below the line they develop much broader flood plains.

2.5 The Coastal Plain

The Coastal Plain Region is made up a thick wedge of Cretaceous and Tertiary sedimentary strata thickening toward the coast as well as dipping toward the southeast, and so they are younger nearer the coast. The sedimentary rocks of the Coastal Plain partly consist of sediment eroded from the Piedmont and Valley and Ridge and partly of limestones generated by various marine organisms and processes.

The South Georgia Mesozoic Basin underlies a portion of the Coastal Plain. This fault-bounded basin contains up to 18,000 feet of aggregate Triassic and younger sediments and igneous material. This basin is similar in genesis, history and contents to the Richmond Basin of Virginia. Both basins contain terrestrial sediments and scattered lake sediments that may hold

organic matter that could have sourced oil or natural gas. The South Georgia basin is not considered a likely source of economic hydrocarbons (USGS, 1995).

Subsurface Stratigraphy and Structure

The stratigraphic section in Georgia includes rock and sediment units from Pre-Cambrian to Holocene in age and includes igneous, metamorphic and sedimentary rock types as well as loose sediments. Figure 3 exhibits a generalized stratigraphic column for the State.

It should be noted that while surface geologic relationships have received a great deal of effort and study, subsurface conditions with respect to stratigraphic and structural relationships have not been explored with extensive drilling programs. The most recent data relative to exploratory drilling in the State is information compiled by the Georgia Geological Survey and included in Information Circulars 51 and 71 titled “Petroleum Exploration Wells in Georgia” and “Petroleum Exploration Wells in Georgia 1979-1984” respectively (Swanson, David E. and Gernazian, Andrea, 1979; Steele, William M, 1986). The circulars report that only 168 test wells had been drilled in the State since 1903 and of those tests 115 have been drilled to depths in excess of 2,500 feet (Swanson, & Gernazian, 1979 and Steele, 1986).

Figure 1: Geologic Regions of Georgia

Figure 2: Map of Geology in Georgia

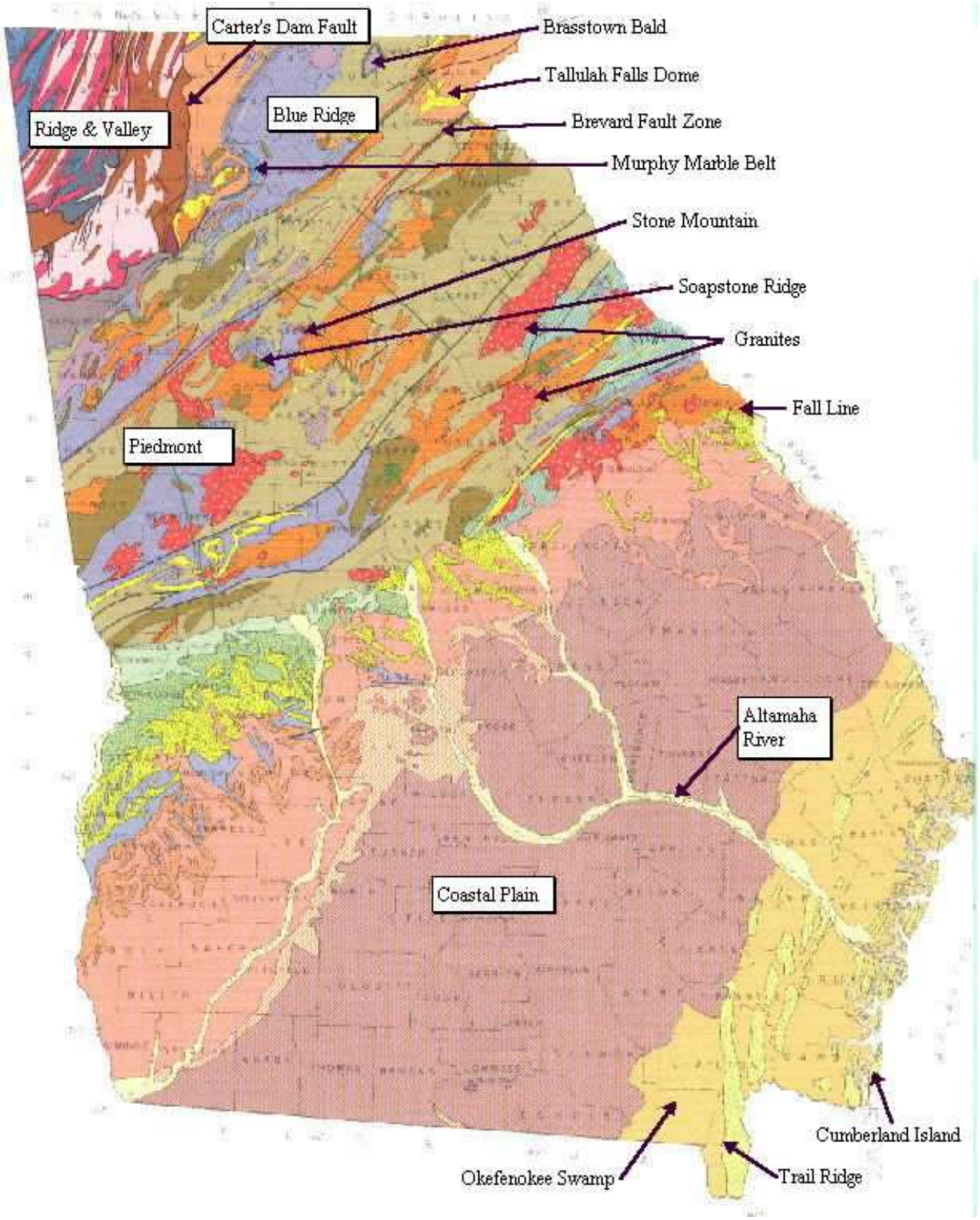

Figure 3: Generalized Stratigraphic Column of Georgia

<table>
<tr><th>Era</th><th>System</th><th>Series</th><th>Stage</th><th colspan="4">Group and Formation</th></tr>
<tr><td rowspan="15">Cenozoic</td><td rowspan="2">Quaternary</td><td>Holocene</td><td rowspan="2"></td><td colspan="4" rowspan="2"></td></tr>
<tr><td>Pleistocene</td></tr>
<tr><td rowspan="13">Tertiary</td><td rowspan="2">Pliocene</td><td rowspan="2"></td><td>Western</td><td colspan="3">Eastern</td></tr>
<tr><td>Miccosukee Frm.</td><td colspan="2">Citronella Frm.</td><td>Charlton Frm.</td></tr>
<tr><td rowspan="2">Miocene</td><td rowspan="2"></td><td>Western</td><td colspan="3">Eastern</td></tr>
<tr><td>Hawthorn Formation
Tampa Lst.</td><td colspan="3">Hawthorn Formation</td></tr>
<tr><td rowspan="3">Oligocene</td><td>Chickasawhayan</td><td>Western</td><td colspan="3">Eastern</td></tr>
<tr><td rowspan="2">Vicksburgian</td><td colspan="4">Suwannee Lst</td></tr>
<tr><td>Glendon Limestone
Tallahatta Formation</td><td colspan="3">Suwannee Lst</td></tr>
<tr><td rowspan="5">Eocene</td><td rowspan="2">Jacksonian</td><td colspan="2">Western</td><td>Eastern</td><td>Downdip Facies</td></tr>
<tr><td colspan="2">Ocala Lst.</td><td>Barnwall Lst</td><td>Ocala Lst.</td></tr>
<tr><td rowspan="2">Claibornian</td><td colspan="2">Lisbon Frm.</td><td>Mc Bean Frm.</td><td>Avon Park Lst</td></tr>
<tr><td colspan="2">Tallahatta Frm.</td><td rowspan="3">Undiffer.</td><td>Lake City Lst.</td></tr>
<tr><td rowspan="2">Sabinian</td><td rowspan="2">Wilcox Gp.</td><td>Hatchetigbee</td><td rowspan="2">Oldsmar Lst.</td></tr>
<tr><td>U. Paleocene</td><td>Tuscahoma Sd</td></tr>
<tr><td>L. Paleocene</td><td>Midwayan</td><td colspan="2">Clayton Frm.</td><td>Cedar Keys Lst.</td></tr>
<tr><td rowspan="7">Mesozoic</td><td rowspan="5">Cretaceous</td><td rowspan="4">Gulfian</td><td rowspan="3">Navarroan</td><td colspan="2">Western</td><td>Eastern</td><td>Downdip Facies</td></tr>
<tr><td colspan="2">Providence Sd.</td><td rowspan="4">Undifferentiated</td><td>Lawson Lst.</td></tr>
<tr><td colspan="2">Ripley Frm.</td><td rowspan="3">Rocks of Taylor and Austin Age</td></tr>
<tr><td colspan="2">Cusseta Sandstone</td></tr>
<tr><td>Tayloran</td><td colspan="2" rowspan="2">Blufftown Formation</td></tr>
<tr><td>Austian</td><td colspan="2">Eutaw Formation</td></tr>
<tr><td>Eagle Ford
Woodbine</td><td colspan="2">Tuscaloosa Formation</td><td>Atkinson Frm.</td></tr>
<tr><td>Comanchean</td><td>Washita & Trinitian</td><td colspan="4">Undifferentiated</td></tr>
<tr><td>Jurassic</td><td></td><td colspan="5">Not recognized</td></tr>
<tr><td>Triassic</td><td colspan="6">Newark Group</td></tr>
<tr><td rowspan="6">Paleozoic</td><td>Pennsylvanian</td><td></td><td colspan="3">Lookout Sandstone</td><td rowspan="5">These formations are not recognized in the Piedmont Province

Formal stratigraphic names have not been assigned to rocks of Paleozoic age that underlie Coastal Plain sediments</td></tr>
<tr><td>Mississippian</td><td></td><td colspan="3">Bangar Limestone
Floyd Shale and Fort Payne Chert</td></tr>
<tr><td>Devonian</td><td></td><td colspan="3">Chattanooga Shale
Frog Mountain Limestone / Armuches Chert</td></tr>
<tr><td>Silurian</td><td></td><td colspan="3">Red Mountain Formation</td></tr>
<tr><td>Ordovician</td><td></td><td colspan="3">Sequatchie Formation
Chickamauga Group</td></tr>
<tr><td>Cambrian</td><td></td><td colspan="3">Knox Group
Conasauga Group
Rome Formation
Shady Dolomite
Chilowee Formation</td></tr>
<tr><td>Pre-Camb.</td><td></td><td></td><td colspan="5">Undifferentiated Crystalline Rocks</td></tr>
</table>

After (Swanson, David E. and Gernazian, Andrea, 1979)

3.0 SUMMARY OF USGS PLAY DESCRIPTIONS FOR THE STATE OF GEORGIA

The most recent oil and gas assessments for the three geologic provinces that are within Georgia were completed in 1995; The Blue Ridge Thrust Belt (068), piedmont (069) and the Atlantic Coastal Plain (070). In each of these province assessments a number of conventional and unconventional oil and gas plays were assessed however none indicate the presences of oil and gas in Georgia.

The East Coast Mesozoic Basins also extend into parts of Georgia however only hypothetical plays exist and no oil or gas has been found.

The primary source materials for this summary presentation are the geologic reports for each of the province assessments as published by the USGS and are available at the USGS National Oil and Gas Assessment website (http://energy.cr.usgs.gov/oilgas/noga/).

A copy of the USGS province report is available for review in Appendix A.

4.0 PAST AND PRESENT OIL AND GAS EXPLORATION ACTIVITY

4.1 Geophysical and Geochemical Surveys

No extensive geophysical or geochemical surveys have been undertaken in Georgia in recent years (Costello, 2008).

4.2 Exploratory Drilling and Success Rates

The success rates as reported from Georgia Geologic Survey information circulars indicate that of the 168 wells drilled in Georgia to date all have been dry holes. past production by county.

4.3 New Field and Reservoirs

No new fields or reservoirs have been discovered.

5.0 OIL AND GAS ACTIVITY IN GEORGIA

This section deals with the current status of oil and gas activity in Georgia based on information provided by both public and private sources. Information includes; leasing activity, well spacing requirements, drilling permits by county, drilling practices, production statistics, oil and gas characteristics, oil and gas prices, operational costs (drilling and completion), conflicts with other mineral development, and gas storage fields.

5.1 Leasing Activity

Discoveries of Cambrian-age shale-gas from the Conasauga Shale in the Alabama Big Canoe Creek Gas Field have sparked some leasing activity in one county in northwest Georgia, Chattooga County. While leasing has been going on in Georgia, there have been no applications submitted for any oil or gas drilling in recent years (Castello, 2008).

5.2 Regulations

The Georgia Oil and Gas and Deep Drilling Act was past in 1975.The act provides the authority for regulating all petroleum exploration wells, including any type of well drilled deeper than 1,800 feet, or any well drilled in an environmentally sensitive area. The act stipulates that each well drilled and abandoned be done in a manner that protects the State's fresh water resources, that geologic data obtained from test wells be made available to the public. The act also specifies how petroleum production is to be regulated when, and if, producible quantities of petroleum are found.

5.3 Drilling and Completion Statistics

5.3.1 Drilling Practices

The vast majority of drilling operations in Georgia are standard vertical tests drilled with air rotary equipment that vary in depth from 800 feet to 10,000 feet. This range of is based on the drill site's elevation and general position on regional structural features with the average well depth in the order of 2,000 feet (Steele, 1986). The deepest vertical test drilled to date reached a depth of approximately 11,470 feet.

5.3.2 Drilling and Completion Costs

Information regarding drilling costs and well completion costs was not available for the exploration wells drilled in Georgia.

5.4 Production Statistics

5.4.1 Crude Oil

There has been no crude oil produced in Georgia.

5.4.2 Natural Gas

There has been no natural gas produced in Georgia.

5.5 Conflicts with Other Mineral Development

Mineral development in Georgia is not in conflict with the exploration for oil and gas.

5.6 Gas Storage Fields

EIA gas storage data for 2006 indicates that there are no gas storage fields operating in the State of Georgia (EIA website, Natural Gas Storage, Form EIA-191 Data, 2007).

6.0 OIL AND GAS OCCURRENCE POTENTIAL

Wells have been drilled for petroleum in the Georgia Coastal Plain, but a scarcity of petroleum-generating source rocks seems to have resulted in the apparent absence of oil and gas. Petroleum exploration nonetheless continues, if slowly, in the Georgia Coastal Plain. For example, in late October 1996, two wells were apparently drilled in Dooly and Crawford Counties, and that a permit had been issued for a 16,000 foot well in Turner County. The latter was to be drilled by Surface Exploration Resources of Dallas, Texas, and if it reached its permitted depth it would be the deepest well drilled in Georgia (UGA, 2008).

The latest compilation of oil and gas activity in the state (Steele, 1986) list 18 wells drilled in the span of 1979 to 1984. One well was drilled in the Cumberland Plateau, one in the Piedmont, and the others were drilled into the Coastal Plain. Total footage drilled was approximately 87,000 feet with the deepest well being 11,470 feet. Prior to 1979, 163 wells had been drilled in the state since 1903. All wells have been dry.

Coal is present in the northeast corner of Georgia, in Valley and Ridge counties of Dade, Chattanooga, Walker, and Floyd. Five seams, which underlie all of Lookout, Sand, and Pigeon Mountains, have produced most of the coal mined in the state. Abandoned mines, some associated with Confederate coal mining during the Civil War, are located in this coal field. Georgia coal reserves are typically low sulfur (less than one percent), low-to-medium volatile, bituminous deposits. Although there is currently no active coal mining in the state, there was some surface and underground mining as late as the 1970's and early 1980's. Coal Bed Natural Gas (CBNG) resources may be present under the Valley and Ridge Region near the now-abandoned coal mines but there are no indications at the present time. Figure 4 indicates the federal lands in Georgia.

7.0 OIL AND GAS DEVELOPMENT POTENTIAL

No oil and gas wells are forecast to be drilled in Georgia in the next ten years. This is consistent with the fact that the US Bureau of Land Management has never issued an oil and gas drilling permit for the State of Georgia.

Figure 4: Federal Lands in Georgia

8.0 REASONABLE FORESEEABLE DEVELOPMENT BASELINE SCENARIO ASSUMPTIONS AND DISCUSSION

This RFD scenario assumes that all potentially productive areas are open under the standard lease terms and conditions except those areas designated as closed to leasing by law, regulation, or executive order. The areas closed to leasing typically include Areas of Critical Environmental Concern (ACECs), Wilderness Study Areas (WSAs) and USFWS Wildlife Refuges. The RFD scenario contains projections for the number or wells and acres disturbed for these counties. This in no way is intended to imply that the BLM are making decisions about the Forest Service lands or the USFWS lands. The predictions are intended to provide the information necessary so that all potential cumulative impacts can be analyzed. The disturbance for each well is based on the typical depth of wells for an area; generally, shallow gas wells disturb fewer acres than deeper oil wells. The assumptions for conventional oil and gas are as follows:

The number of wells was calculated based on historical statistics and data trends as follows:

- Wells drilled to date were taken from the Georgia Department of Natural Resources, Information Circulars.
- The number of wells drilled to date was statistically analyzed to calculate a median per year wells drilled per county.
- The data trends associated with the last 6 years (2001-2006) represents a more accurate estimate of future development trends than historical data, thus, it is weighted more heavily.
- The data trends from 1979 to 1984 data set are a more accurate estimate of future trends than the complete historical record and were weighted more heavily than the historical record.
- The data trends for the complete historical record (1903 – 1979) represent the least accurate estimate of future development trends and, thus, it was weighted the lightest.
- For each geographic/geologic boundary region and sub region, the calculated estimates for future development were summed to obtain a per year well count.
- Wellhead oil and gas prices are a driving force for well drilling and completion; current prices are historically high and have resulted in increased activity throughout the state. An estimate of activity for the future well development to into consideration this influence. The forecast assumes wellhead oil and gas prices will remain high and development over the next 10 years will continue at an elevated rate.
- Estimates of well counts for the different mineral ownership entities are based on spatial analysis of the percent of mineral ownership within each county times the total number of producing wells anticipated to be developed in that boundary area.
- The average acreage figure (acres per well) for the resource area was used to estimate federal disturbed acres.
- The RFD projections have a 10-year life.
- The number of dry holes was determined based on historic analysis of dry holes in the geologic boundary areas.

The assumptions were used to calculate the number of wells to be drilled, the number of in-field compressors, and the number of sales compressors required.

9.0 SURFACE DISTURBANCE DUE TO OIL AND GAS ACTIVITY ON ALL LANDS

9.1 Surface Disturbances

There are no estimates of the surface disturbances associated with the development of oil and gas on federal minerals within the State of Georgia because no new wells are predicted to occur over the next ten years.

10.0 REFERENCES

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University of Georgia, Department of Geology, website, 2008 http://www.gly.uga.edu/

Appendix A

USGS Play Descriptions